Forest biomass use for energy in Portugal

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Abstract

A strong bioenergy boom is underway in Portugal. Not only forest biomass, but also other renewable resources, such as solar, wind, and waves, are thoroughly considered, when different bioenergy solutions are made locally. More than 15 different power plants using forest biomass have been planned to build in Portugal in coming few years.

Accumulating felling head for whole tree harvesting is a rational installation for farm-tractors to conduct energy wood harvesting. In Portugal, there is a call for farm-tractor based energy wood harvesting concepts. According to the latest expert reports and opinions, when operating with eucalypts, the need for enough big base machine and a felling head with high cutting power are necessary to accomplish the adequate functionality and productivity.

A field trip to stump and root extraction area showed one supply line of forest biomass for energy use. In general, from the total stump and root resources of final fellings, about 50 % are utilized for energy use.

The key issue is the supply of forest biomass to energy use and the adequacy of biomass resources in Portugal. In addition, forest fires are a big problem for rational forest use and management. This destroys the utilizing possibilities of forest biomass not only from wood industry but also from bio power plants. Moreover, private forest owners have to be activated to manage better their own forest holdings.

Preface

This report is a national demo report (WP3) of the 5EURES – Five European RES-Heat Pilots – project (EIE/04/086/S07.38582). In WP3 of 5EURES local feasibility studies, case studies and demonstrations are performed. The main objective of the 5EURES project is to increase of the actual energy produced from bioenergy in the EU. In WP3, the target is to create regional bioenergy producing and/or using pilots. The target is achieved through feasibility studies, case studies and demonstrations.

The Finnish Forest Research Institute's researchers, Kari Väätäinen and Yrjö Nuutinen made a trip to Portugal in 25th and 30th of Mars. Main intention of the trip was to observe energy wood harvesting and make time studies for the Naarva Grip energy head attached to farm-tractor. Since the functional problems in the accumulating felling head, we had no chance to make demonstrations and work studies of the particular device during our trip. Alternatively, we had a possibility to discuss with the Pentin Paja Company's (manufacturer of Naarva grip felling heads) sales manager, Mr. Seppo Honkanen, who was demonstrating the equipments in the fair, in Portugal (23rd and 24th of Mars). In addition, we had a field trip in the extraction place of stumps and roots in a motor way constructing area, where we had a possibility to observe the operations. Finally, we participated in International Seminar on Advanced Decentralised Energy Generation in Setúbal, Portugal. There we had a presentation named; The Supply of Forest Based Biomass for Energy – Technology and Logistics. We thank sincerely Elsa Nunes from Irradiare and Mr. Ulysses for organizing the field trip and offering the possibility to give a speech in the bioenergy seminar.

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1. Introduction

1.1 Goals for forest biomass use for energy in Portugal

A strong bioenergy boom is underway in Portugal. Not only forest biomass, but also other renewable resources, such as solar, wind, and waves, are thoroughly considered, when different bioenergy solutions are made locally.

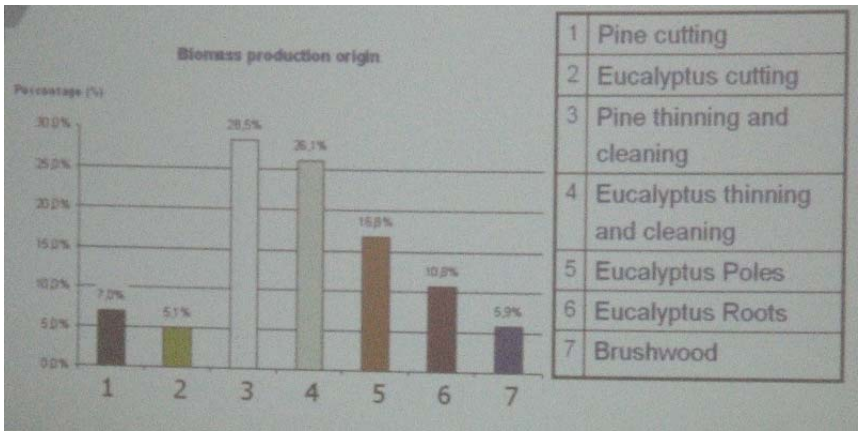

Figure 1. The share of different cutting types in forest biomass harvesting in Portugal.

In Portugal, the total bio energy electric power potential for forest biomass was estimated to be 6 %. Forest biomass potential consists mainly on both eucalyptus and pine thinnings and cleanings, representing 55 % of the total forest biomass production in Portugal (figure 1). In addition, roots and stumps of eucalyptus and pine have been harvested for bioenergy. Today, more than 15 different power plants using forest biomass have been planned to build in Portugal (figure 2). The total energy production of these planned power plants is 200 MW corresponding 2 milj. tonnes of biomass per annum. The big question has risen: Is there the capacity to support this consumption in Portugal?

Forest fires are a big problem for rational forest use and management. This destroys the utilizing possibilities of forest biomass not only from wood industry but also from bio power plants. Lack of raw material leads to closing of wood industry enterprises: in about 8 years, the number of industries on first transformation went from 730 to less than 300. In addition, the structure of forest ownership limits the efficient forest

utilization. Most of the private forest owners have really small holdings, which makes reasonable and practical forest operations difficult.

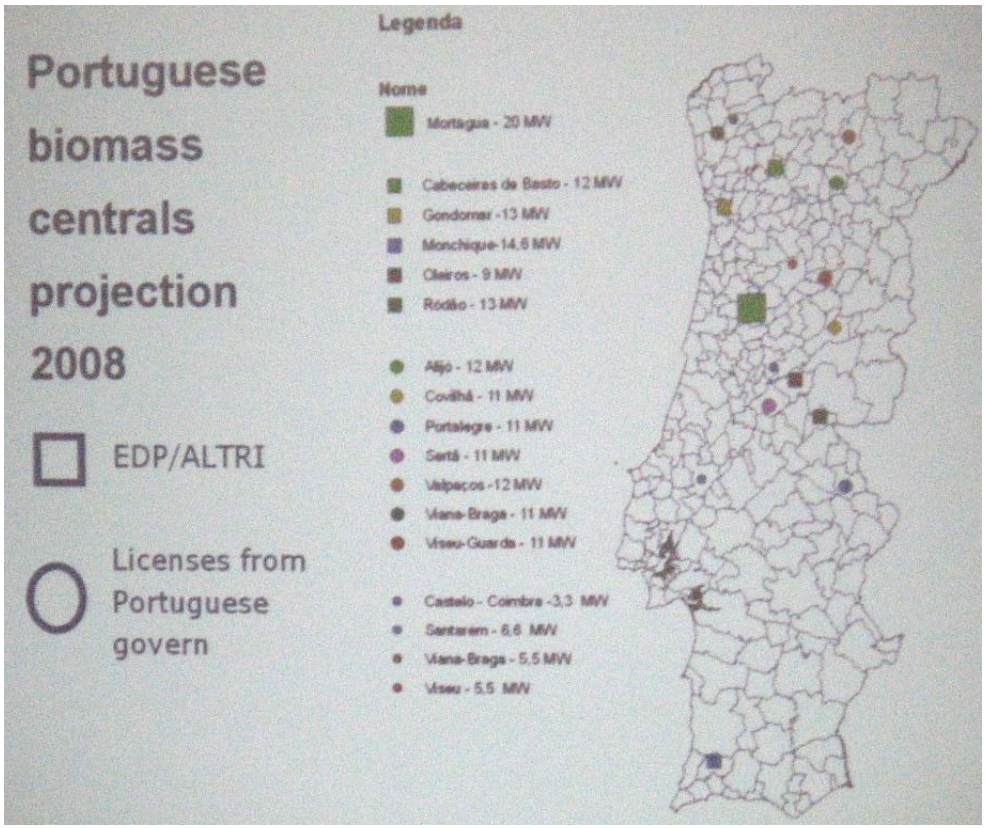

Figure 2. Projected biomass power plants to be established in Portugal up to year 2008.

However, the biomass production of eucalyptus plantations is very effective. The general treatment of eucalyptus stands is to have three stand rotations after planting the seedlings. Clear cuttings are made every 12 years (12, 24, 36 years) and thinnings are made in years of 15 and 27 after planting. After the third final cut stumps and roots (S&R) of eucalyptus are harvested. It is estimated that approximately 50 % of final cut stands the S&R harvesting is made. Correspondingly, for pine stands the tree rotation is 50 years and before final cut is made one thinning.

2. The use of Naarva Grip energy head in harvesting of whole trees for energy

The first intention of our trip was to observe energy wood harvesting and make time studies for the Naarva Grip energy head attached to big Valtra farm-tractor (see figure 3). Due to the failure of the felling head, we had not any possibility to conduct the time studies during the visiting time in Portugal. Nevertheless, the harvesting operation with Naarva grip accumulating felling head (model 1500-25E) was demonstrated in local fair of forest machines for bioenergy in Portugal 23.-24.3.2007. Main technical features of this model were the guillotine blade for cutting the tree, maximum cutting diameter of 25 cm and accumulating clutches for collecting few stems to the grip before the bunching.

Figure 3. Naarva Grip accumulating felling head attached to farm-tractor.

In the following, there are expressed some issues related to the whole tree harvesting with the guillotine based felling heads, according to discussions with Mr. Honkanen. In general, in Portugal, there are many farm-tractors and other light machinery suitable as base machines for wood energy operations. Moreover, a local manufacturing, small metal works, are producing several kinds of devices for these purposes. The advance of those equipments is the cheap investment compared to imported ones. Nevertheless,

felling heads for energy wood harvesting equipped to farm-tractors have a European wide call nowadays. Therefore, the exporting of energy heads with high quality and productivity has its importance.

Light energy head attached to farm-tractor's crane is one option in harvesting small and medium sized whole trees for energy use. The most interesting issue in operating with felling heads with guillotine blade cutting is the efficiency of cutting hard woods, such as eucalyptus. According to Mr. Honkanen, for operating with eucalyptus stands, there should be bigger felling heads with more power especially in cutting phase. Additionally, bigger felling head requires bigger base machines. Nevertheless, the biggest manufactured farm-tractors are suitable for operating with felling heads of this size (such as Naarva Grip 1500-40E) having weight of about 400 kilos. The average size of removable stems (close to 20-25 cm) requires also big enough felling heads.

The wood material of eucalyptus is very hard, and cutting with the guillotine blade needs a lot of power. The study (Laitila et al. 2006), where the productivity of Naarva Grip 1000-23 felling head was studied with some hardwoods and spruce in Slovakia, could be generalized relatively well to cuttings of the eucalyptus. The study revealed that stem processing time for hardwoods (oak, beech and hornbeam) was somewhat 65 % longer than for spruce, when the stump diameter of the stems was 15 centimetre. The longer stem cutting time, due to the hard and heavy wood material of hardwoods, explained the resulted time difference (Laitila et al. 2006).

The density of the wood material has a straight correlation on the cutting time of felling heads functioned by the guillotine or blade cut. For example, according to Hamilton (1975) the fresh density of oak and beech were 1060 kg/m³ and 1030 kg/m³, whereas the fresh density of the most common eucalypts tree species varies from 1100 to 1200 kg/m³ (Feature Timber 2007, NCAS technical report 2007). Both the hardness of the wood and the weight of the tree have to be taking into account, when finding feasible solutions for energy wood harvesting with blade cutting felling heads in eucalyptus stands.

The option to use chain cutting is problematic in eucalypt stands due to sand and other mineral particles in the stump and bottom section of trees. The chain systems get dull relatively quickly, and therefore, the productivity decreases. As a common method in Portugal, cutting operations are mainly made manually with motorsaws. According to Mr. Honkanen, there have been calculations to find out that one harvester or farm-tractor with accumulating felling head could replace even 8 to 10 chain saw workers.

3. Fieldtrip to stump extraction area – steps of the operation-cycle

In general, from the total stump and root resources of final fellings, about 50 % are utilized for energy use. Most of the S&R are taken from the managed forest. In addition, S&R extraction is done in bigger road construction areas, which was the case in our field trip to Tocha (in Barrins region, about 270 km from Lisbon).

Figure 4. Field trip representatives (from left to right) were Ricardo Savara from ForesTech Ltd., Elsa Nunes from Irradiare, Kari Väätäinen from METLA, Ulysses from University of Engineering and Yrjö Nuutinen (photographer) from METLA. Surrounding is the area of road construction.

From the road construction corridor (Figure 4) the stumps and all bigger roots of cut trees are lifted from the soil with the excavator based stump lifting machine (Figure 5). The minimum weight of the stump-lifting excavator is 28 tonnes. Before lifting stumps are split to a certain size, which is feasible for further processing of the comminuting cycle (Figure 6). The accessory of S&R splitting-lifting device is Portuguese made and ForesTech company owns two units of them. When the lifted stumps per hectare are 900, the productivity of S&R lifting is 40 to 45 tonnes per ha and 1.5 ha per 8 hours.

Figure 5. Stump and root lifting with a 28 tonne excavator in Portugal.

Figure 6. Splitted stump right before lifting from the soil.

On the road-construction corridor, split and lifted stumps are push to the roadside storage by bulldozers. Long lines of stump piles are waiting for further processing. Secondly, tracked lifting machine with long crane and a special grapple scoop lifts S&R particles to the loadspace of a dumper (Figures 7, 8 and 9). During this work cycle, some of the sands and stones are removed from the crushable S&R material. Dumpers transport the S&R material to bigger piles waiting for the crushing process to the road side storage.

Figure 7. Tracked lifting machine is loading the dumper with split stumps and roots.

Figure 8. Purpose build scoop suits for handling S&R material and wood chips.

Figure 9. Elevating cabin improves the visibility and therefore the productivity.

The crushing process consists of three machines. In the crushing cycle, most of the unwanted particles, such as sand and stones, are removed with 3-phase method. The first machine in the crushing cycle (mobile-crusher, Eurec Z 85) conducts the pre-chipping, which means crushing the splitted S&R material to 30–40 cm size particles. The productivity of the crusher is about 25–30 tonnes/hour. At the second phase of the process, the separator machine (Hammel-separator) removes most of the unwanted particles and forwards the wood material to the third phase of the crushing with a conweyor. In the final phase, a mobile-crusher (CB 1 hammer-crusher) chips the pre-processed wood material and separates the normal sized chips and wood dust. The joint-productivity of these two final phases of the process is about 35 to 40 tonnes per hour. Usually, the by-product from the crushing process, the smallest wood particles or wood dust, is recycled back to the forest soil for returning some of the nutrients.

The long distance transporting is carried out with the truck-semitrailer systems. The capacity of the trailer's containers is approx. 90 loose-m^3. The long distance translocation costs represents the biggest share of the total harvesting costs of the S&R material from the lifting area up to the end use facility.

4. Conclusions

A strong bioenergy boom is underway in Portugal. Several bio power plants (mostly CHP) are scheduled to be establish in Portugal in coming years. The key issues are the supply of forest biomass to energy use and the adequacy of biomass resources in Portugal. The government has a key role in managing and confirming the “green steps” towards larger forest biomass use for energy. There is a need of subsidies in launching local practical bioenergy projects, where many participants and work force are involved. In addition, private forest owners have to be activated to manage better their own forest holdings. Forest fires can be a big obstacle towards more efficient use of forest biomass resources. A common attitude and goals are clear: more green energy with the use of renewable resources.

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